



制冷空调行业 绿色替代技术进展

Progress of Green Substitution in RAC Industry

中国制冷空调工业协会

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1 中国政府高度关注节能减排事业

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Chinese government attaches great importance to energy saving and emission reduction

- ❖ 在第75届联合国大会上中国明确提出，力争CO₂排放2030年前达到峰值、2060年前实现碳中和。首次向全球明确了中国碳中和时间表。

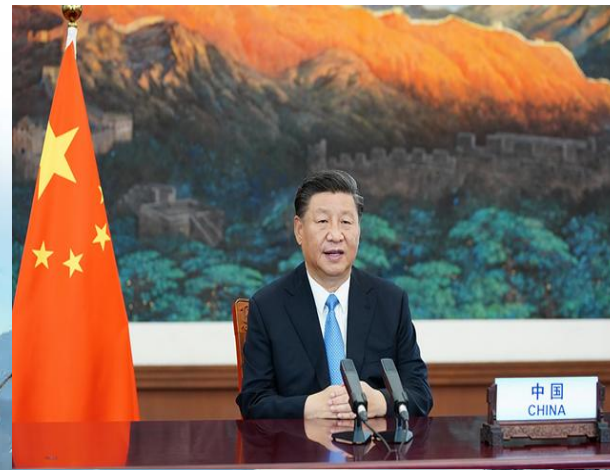
At the 75th United Nations General Assembly, China clearly stated that it will strive to reach a peak in CO₂ emissions by 2030 and achieve carbon neutrality by 2060. For the first time, the timetable for China's carbon neutrality has been clarified to the world.

- ❖ 十四五规划：落实2030年应对气候变化国家自主贡献目标，制定2030年前碳排放达峰行动方案。

The 14th Five-Year Plan: implement the nationally determined contribution target for climate change in 2030, and formulate an action plan for peaking carbon emissions by 2030.

- ❖ 中央经济工作会议：要求抓紧制定2030年前碳排放达峰行动方案，支持有条件的地方率先达峰。

The Central Economic Work Conference: It is required to promptly formulate an action plan for peaking carbon emissions by 2030, and support places where have conditions to reach the peak first.



1 中国政府高度关注节能减排事业

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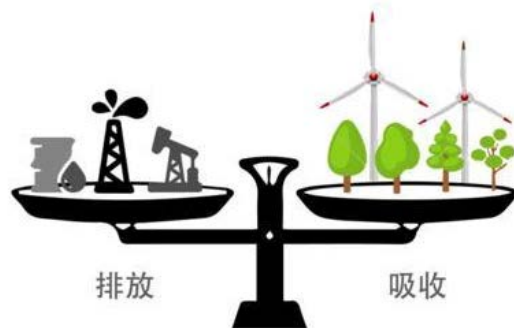
Chinese government attaches great importance to energy saving and emission reduction

- ❖ 生态环境部、国家发展和改革委员会、工业和信息化部、财政部、国家能源局、中国人民银行等相继出台碳达峰和碳中和相关政策和行动。

The Ministry of Ecology and Environment, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Finance, the National Energy Administration, and the People's Bank of China have successively released policies and actions related to carbon peaking and carbon neutrality.

- ❖ 31省、直辖市、自治区开展碳达峰、碳中和的工作部署，80多个低碳试点城市研究提出碳达峰目标。

31 provinces, municipalities directly under the Central Government, and autonomous regions have carried out the deployment of carbon peak and carbon neutral work, and more than 80 low-carbon pilot cities have researched and put forward carbon peak targets.



绿色高效制冷行动方案

Green Efficient Cooling Action Plan



- ❖ 国家发改委、生态环境部等七部委于2019年6月13日联合发布“绿色高效制冷行动方案”，主要目标：

Seven ministries including the National Development and Reform Commission and the Ministry of Ecology and Environment jointly issued the "Green Efficient Cooling Action Plan" on June 13, 2019. The main goals are:

- ✓ 到2022年，家用空调、多联机等制冷产品的市场能效水平提升30%以上，绿色高效制冷产品市场占有率提高20%，实现年节约1000亿千瓦时。

By 2022, the market energy efficiency level of refrigeration products such as room air conditioners and multi-split air-conditioning units shall increase by more than 30%, and the market share of green and efficient refrigeration products shall increase by 20%, achieving annual power savings of about 100 billion kWh.



绿色高效制冷行动方案

Green Efficient Cooling Action Plan



- ✓ 到 2030 年，大型公共建筑制冷能效提升 30%，制冷总体能效水平提升 25% 以上，绿色高效制冷产品市场占有率提高 40% 以上，实现年节电 4000 亿千瓦时左右。

By 2030, the refrigeration energy efficiency of large public buildings shall increase by 30%, the overall energy efficiency of refrigeration shall increase by more than 25%, the market share of green and high-efficiency refrigeration products shall increase by more than 40%, and the annual electricity saving shall be about 400 billion kWh.



绿色高效制冷行动方案

Green Efficient Cooling Action Plan



❖ 针对制冷剂替代提出任务目标:

Objectives for the replacement of refrigerants:

- ✓ 严格落实《消耗臭氧层物质管理条例》和《蒙特利尔议定书》，引导企业加快转换为采用低 GWP 制冷剂的空调生产线，加速淘汰HCFCs制冷剂，限控HFCs的使用。

Strictly implement the "Regulations on the Management of Ozone Depleting Substances" and the "Montreal Protocol", guide enterprises to accelerate the conversion to low GWP refrigerants air-conditioning production lines, accelerate the phase-out of HCFCs refrigerants, and limit the use of HFCs.

- ✓ 加快制修订制冷行业用环保制冷剂产品标准和安全标准，促进低GWP替代产品的推广应用。

Speed up the formulation and revision of environment-friendly refrigerant product standards and safety standards, and promote the marketing of low GWP technologies and products.



消耗臭氧层物质
管理条例

中国法制出版社

绿色高效制冷行动方案

Green Efficient Cooling Action Plan



- ✓ 加大环保制冷剂的研发，积极推动制冷剂再利用和无害化处理。

Increase the research and development of environment-friendly refrigerants, and actively promote the reuse and harmless treatment of refrigerants.

- ✓ 鼓励制冷产品生产企业创建绿色工厂，严格控制生产过程中制冷剂的泄漏和排放。

Encourage manufacturers of refrigeration products to create green factories and strictly control the leakage and discharge of refrigerants during the production process.



2 制冷空调行业全面推进绿色替代

R&AC industry fully promotes green substitution



- ❖ 2007年9月《蒙特利尔议定书》第19次缔约方大会上，国际社会达成了加速淘汰HCFCs的议案。

At the 19th Conference of the Parties to the Montreal Protocol in September 2007, the international community reached the adjustments to the MP.

- ❖ 中国作为全球最大的制冷空调产品生产国和消费市场。HCFCs加速淘汰对全行业而言，意味着重大的任务和挑战。

China is the worldwide largest producer and consumer market for refrigeration and air-conditioning products. It is significant tasks and challenges for the total industry to accelerate HCFCs phase-out.

- ❖ 为了履约目标的达成，中国制冷空调行业积极动员，全面启动HCFCs的淘汰转换行动并取得良好成效。

In order to achieve the goal of the MP, China's R&AC industry has actively initiated the conversion actions on HCFCs phase out, and achieved good results.

优先采用臭氧气候友好的技术

Priority should be given to ozone climate friendly technologies



- ❖ 中国制冷空调行业在实施HCFCs的淘汰转换过程中，从对环境负责的角度出发，优先选择臭氧气候更加友好的替代技术，在保障达成HCFCs淘汰任务目标的同时，赢取更大的温室气体减排协同效应。

In the process of HCFCs phase-out and conversion, China's R&AC industry's priority choice is to choose more environmental friendly alternative technologies, to ensure the achievement of HCFCs phase-out target, and gain more synergistic effect of greenhouse gas emission reduction.

优先采用臭氧气候友好的技术

Priority should be given to ozone climate friendly technologies



- ❖ 目前行业内多种产品领域在 NH_3 、 CO_2 、R32、HC、HFO及其混合物等绿色低碳替代技术和产品的推广应用方面取得巨大成功，这些工作有效推动了行业的转型升级和绿色可持续发展。

At present, many product areas in the industry have achieved great success in the promotion and application of green and low-carbon alternative technologies and products, such as NH_3 , CO_2 , R32, HC, HFOs and HFOs blends. These efforts have effectively promoted the transformation and upgrading of the industry, as well as green and sustainable development.

替代技术研发项目

R&D Projects for Alternative Technology



- ❖ 在HPMP实施过程中，中国行业内先后组织实施了多个低GWP替代技术研发项目，为第一、第二阶段行业计划的顺利实施以及今后更长时期内的技术选择提供了重要的技术支撑和支持。

During the implementation of HPMP, the Chinese industry has successively organized and implemented a number of research and development projects for low-GWP alternative technology, which provides important technical support for the implementation of the HPMP, and for the technologies selection in the future.





替代技术研发项目

R&D Projects for Alternative Technology

序号No.	项目名称 Projects
1	针对使用弱可燃HFC-32制冷剂的制冷空调设备制造与使用安全技术标准的前期研究 Preliminary study on safety technical standards for the manufacture and use of refrigeration and air-conditioning equipment using weakly flammable HFC-32 refrigerant
2	工商制冷行业应用HFC-32制冷剂的适用性研究 Research on the applicability of HFC-32 refrigerant in industrial and commercial refrigeration industry
3	工商制冷行业应用天然工质的适用性研究 Research on the applicability of natural refrigerants in industrial and commercial refrigeration
4	R290 大功率商用热泵机组开发项目 R290 high-power commercial heat pump unit development project
5	商用CO ₂ 热泵热水机关键技术的研究 Research on Key Technology of Commercial CO ₂ Heat Pump Water Heater
6	HFO 冷水机组的开发与应用潜力分析 Analysis of Development and Potential Application of HFO Chiller
7	CO₂ 制冷在超市冷链中应用的成套技术开发 Development of Complete Set Technology for Application of CO ₂ Refrigeration in Supermarket Cold Chain
8	低GWP制冷剂在列车空调中的应用研究 Application of Low GWP Refrigerant in Train Air Conditioning
9	R290 空气源冷水热泵机组实验研究项目 R290 Air Source Cold Water Heat Pump Unit Experimental Research Project
10	R513A 制冷剂的应用研究项目 Application research project of R513A refrigerant



- ❖ 在2011-2020期间的第一阶段行业HCFCs淘汰管理计划的实施过程中，大量低GWP替代技术得到了广泛采用：

During the implementation of the HCFCs phase-out management plan (HPMP) during 2011-2020, a large number of low-GWP alternative technologies have been adopted in the industry:

- ✓ 2011-2015，工商制冷空调领域更多的采用了CO₂、NH₃、R32、HFOs等环境友好的替代制冷剂，R134a、R410A等高GWP值的HFCs类制冷剂在第一阶段行业计划的实施项目中仅占不到30%的份额。

From 2011 to 2015, more environmental friendly alternative such as CO₂, NH₃, R32, and HFOs were adopted in the implementation of HPMP. Projects adopted high GWP alternatives such as R134a and R410A only accounted for less than 30%.

2011-2015年HPMP替代技术选用情况 2011-2015 HPMP alternative technology choices

序号 No.	采用的替代制冷剂 Alternative refrigerants	生产线数量 Number of production lines	涉及产品种类 Involved product types
1	HFC-32	16	小型冷水机组、单元机、压缩机 small-sized water chillers, unitary air-conditioner, compressors
2	CO ₂ /NH ₃	9	压缩机、压缩冷凝机组 compressor, compressor condensing units
3	HFOs	1	压缩机 compressor
4	HFC-134a	5	大中型冷水机组、压缩冷凝机组 Industrial & commercial water chillers (heat pumps), compressor condensing units
5	R410A	5	单元机、多联机 Unitary air conditioner, multi-split air-conditioning (heat pump) units
合计 Total		36	

行业计划实施成效

Implementation effects of HPMP



- ✓ 从2016开始的第二阶段的行业计划的实施过程中，中国行业明确提出不再采用高GWP值的HFCs作为替代技术，并全面推进NH₃、CO₂、R32、HFOs、HC等低GWP替代制冷剂的推广使用。同时大力关注设备能效的提升体现了中国制冷空调行业对国际环境事业负责任的态度，也为未来基加利修正案的实施创造了有利条件。

During the implementation of the second phase of HPMP from 2016, the Chinese industry clearly proposed that HFCs with high GWP values would no longer be used as alternative technologies, and comprehensively promoted the use of low-GWP alternative refrigerants such as NH₃, CO₂, R32, HFOs, and HC etc. and focused on energy efficiency improvement. It shows the responsible attitude of China's R&AC industry to environment protection. It also benefits to the implementation of the Kigali amendment in the future.

行业计划实施成效

Implementation effects of HPMP



HPMP(2016-2020)替代技术选用情况

HPMP(2016-2020) alternative technology choices

序号 No.	采用的替代制冷剂 Alternative refrigerants	生产线数量 Number of production lines	涉及产品种类 Involved product types
1	HFC-32	7	单元机、冷水（热泵）机组 water chillers(heat pump), unitary air-conditioner
2	CO ₂ /NH ₃	6	压缩机、压缩冷凝机组、热泵热水机 compressor, compressor condensing units, heat pump water heaters
3	HFOs	3	螺杆冷水（热泵）机组 screw water chillers (heat pumps)
4	HC-290	3	螺杆冷水机组 screw water chillers
合计 Total		19	

Difficulties and Challenges

- ❖ 新一代零ODP值、低GWP值的替代品，与上一代的HCFCs制冷剂相比，或多或少存在着各种不同的不足和缺陷，如压力过高、容积制冷量低、具有可燃性或毒性等，需要更多的技术投入加以处理解决。

Compared with the previous generation of HCFCs refrigerants, the new generation of alternatives with zero ODP value and low GWP value have more or less different deficiencies and defects, such as excessive pressure, low volumetric cooling capacity, and flammability or toxicity, etc. More cost and technical inputs are required for the solutions.

- ❖ 采用新的替代技术的产品成本有所升高，用户和市场接受度降低，市场推广应用面临很大的困难和压力，需要行业和社会各界携手努力加以克服。

The cost of products adopted new alternative technologies has risen, while market acceptance has decreased. It led more difficulties and pressures on new product marketing. The cooperation between industry and all stakeholders will be the best way to overcome the barriers.



❖ 宣传Propaganda

- ✓ CRAA与生态环境部对外合作与交流中心、UNDP、UNEP等相关国际执行机构密切合作，组织开展路演和圆桌会议活动，广邀国内外同行和市场相关人员参与，宣传环境保护的政策法规，推介国内外替代技术发展和市场动态。

CRAA has been working together with FECO, UNDP, UNEP , to organize roadshow and roundtable, to publicize the policies and regulations of environmental protection and Share the information of alternative technology development and market dynamics.



臭氧气候友好技术市场宣传推广

Promotional activities of O2C friendly technology



- ✓ 发起组织各种形式的ODS淘汰暨HCFCs替代技术发展国际论坛、技术交流会、战略研讨会等宣传和研讨活动，为行业ODS淘汰转换行动的开展创造条件。

Organize various forums, technical exchange meetings, seminars on ODS phase out and HCFCs alternatives technologies. It benefits the industry ODS conversion actions.



❖ 宣传Propaganda

- ✓ 与期刊《制冷与空调》、中国制冷与空调网等专业媒体进行合作，设立制冷剂替代专题，面向行业内广泛宣传和推广臭氧气候友好的替代技术，尽力推动替代技术和产品的市场化。

Cooperate with professional media network, and journal to establish refrigerant substitution topics, widely publicize and promote the O2C friendly technologies, and help to marketing the alternative technologies and products.



❖ 示范和推广 Demonstration and promotion

✓ 环保低碳热泵技术采暖示范

Demonstration project on heat pump heating system adopted environmental friendly technology

✓ CO₂制冷技术在超市的应用示范

CO₂ application demonstration project in supermarket



❖ 绿色冬奥会 Green Winter Olympics

- ✓ 协会与相关机构合作，成功推动在国家滑冰馆等冬奥会场馆建设中实现了CO₂技术方案的选择与实施，实现环保替代，为绿色奥运建设作出贡献。

CRAA cooperated with relevant institutions to successfully confirm CO₂ as the solution in the construction of national skating arena and others stadiums for the Winter Olympic Games.



R32小型商用空调的市场推广

Market promotion of R32 small commercial air conditioners



- ❖ 当前R32在中国家用空调的市场占有率达80%-90%以上。
The current market share of R32 household air conditioners in China is over 80%-90%.
- ❖ 使用R32的小型商用空调也已开始进入批量化生产和市场推广阶段。
The marketing of R32 small size commercial air conditioners has been started.
- ❖ R32的推广应用不仅保障了R22淘汰任务目标的如期达成，同时还取得了非常好的节能效果。
The marketing of R32 products helped to reach the target of R22 phase out, and achieved very good energy-saving effects.



R32小型商用空调的市场推广

Market promotion of R32 small commercial air conditioners



示范推广项目 application demonstration project

序号 No	单位Unit	项目Project	采用 替代技术 refrigerants	类型 Type
1	同方人工环境有限公司 Tongfang Artificial Environment Co., Ltd.	北京顺义新农村安置房空气源热泵采暖项目 New Rural Resettlement House Air Source Heat Pump Heating Project in Shunyi District, Beijing	HFC-32	热泵 Heat pump
2	环境保护部北京会议与培训基地 Beijing Conference and training base of MEE	会议与培训基地热泵采暖与泳池供热替代燃煤锅炉项目 Heating by heat pump instead of coal-fired boiler in the conference and training base and swimming pool	HFC-32	热泵 Heat pump
3	广东澳信热泵空调有限公司 Guangdong ASEAIR Heat Pump Co., Ltd.	山东商业职业技术学院教工宿舍及齐鲁师范学院宿舍楼热泵采暖项目 Heat pump heating projects in the teaching dormitory of Shandong Institute of Commerce & Technology and Technical College and the dormitory of Qilu Normal University	HFC-32	热泵 Heat pump 热泵
4	南京天加空调设备有限公司 Naning TICA Air-conditioning Co., Ltd.	山东济宁2650m ² 酒店空气源热泵采暖项目 air-source heat pump heating project with an area of 2650 m ² in a hotel in Jining, Shandong	HFC-32	热泵 Heat pump
5	浙江盾安人工环境股份有限公司 Zhejiang DunAn Artificial Environment Co., Ltd.	黄河三角洲国家可持续发展研究中心空气源热泵采暖项目 Air source heat pump heating project of Yellow River Delta National Sustainable Development Research Center	HFC-32	热泵 Heat pump

NH₃/CO₂设备的市场推广

Market promotion of NH₃/CO₂ equipment



- ❖ NH₃/CO₂复叠和载冷技术已成为当前中国冷冻冷藏设备的主流技术，获得了广泛的市场化应用，在大中型装备市场的占有率已达80%以上，且NH₃/CO₂技术应用具有极大的节能潜力，获得了市场和用户的广泛认同。

NH₃/CO₂ cascade and secondary refrigerant technology has become the mainstream technology of China's freezer and cold storage sector, and it has been widely applied in the market. And has reached more than 80% share of large and medium-sized equipment. Based on its large energy-saving potential, NH₃/CO₂ technology has been widely recognized by the market and users.

- ❖ CO₂热泵热水机也取得了市场化的商业应用，市场占比开始稳步提升。

CO₂ heat pump water heaters have also achieved good commercial applications, and the market share has begun to increase steadily.



NH₃/CO₂设备的市场推广

Market promotion of NH₃/CO₂ equipment

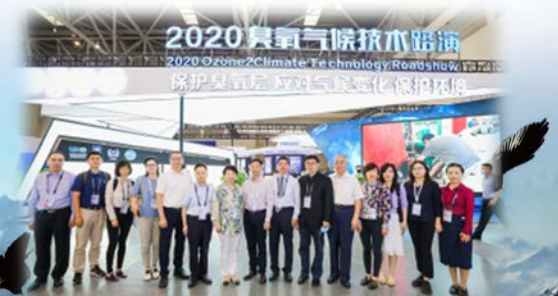


示范推广项目 application demonstration project

序号 No	单位Company	项目Project	采用 替代技术 refrigerants	类型 Type
1	烟台冰轮集团有限公司 Yantai Moon Group Co., Ltd.	青岛平度九联加工厂氨高温热泵采暖、生产生活热水项目 Project of Ammonia high temperature heat pump heating and water heating for production and domestic use in Qingdao Pingdu Jiulian Processing Plant	NH ₃	热泵 Heat pump
2	江苏白雪电器股份有限公司 Jiangsu Baixue Appliances Co., Ltd.	白雪集团厂区生产生活用热泵采暖工程项目 Project of heat pump heating for production and domestic use in Baixue factory	CO ₂	热泵 Heat pump
3	山东美琳达再生能源开发有限公司 Shandong Melinda Quantum New Energy Co., Ltd.	北京兰亭艺术馆多能互补环保性供热空调项目 Multi-energy complementary environmental protection heating and air conditioning project in Beijing Lanting Art Museum	CO ₂	热泵 Heat pump
4	广州北华联设备采购有限公司 青岛海尔开利冷冻设备有限公司 Guangzhou Beihualian Equipment Purchase Co., Ltd. Qingdao Haier-CARRIER Freeze Equipment Co., Ltd.	北华联超市武汉群星城店项目 Qunxingcheng Mall, Wuhan	CO ₂	冷链 Cold chain
5	安徽省徽商红府连锁超市有限责任公司 /艾默生环境优化技术有限公司 Anhui Homeful Supermarket Co., Ltd./Emerson Climate Technologies Co., Ltd.	红府超市合肥中心广场店项目 Central Plaza, Suzhou Road, Hefei	CO ₂	冷链 Cold chain

中国制冷空调行业绿色替代技术的大面积推广应用，不仅确保了行业和国家层面的HCFCs淘汰任务目标的顺利达成，也取得了巨大的温室气体减排协同效益。据初步测算，通过行业计划的实施每年可取得直接减排温室气体超过3600万CO₂当量吨的环境效益，所获得的综合环境效益更是远超预期。

The large-scale promotion and application of green alternative technologies in China's R&AC industry not only ensured the achievement of the HCFCs elimination task at the industry and national levels, but also achieved huge co-benefits of greenhouse gas emission reduction. According to preliminary calculations, direct emission reduction of more than 36 million CO₂ equivalent tons of greenhouse gases can be obtained each year by the HPMP implementation, and the comprehensive environmental benefits obtained are far beyond expectations.



中国政府和行业的贡献获得国际认可



The contribution of the Chinese government and industry is internationally recognized

- ❖ 为纪念《蒙特利尔议定书》签署30周年，2017年11月23日，在加拿大蒙特利尔召开的《关于消耗臭氧层物质的蒙特利尔议定书》缔约方第二十九次会议上，中国生态环境部（原环境保护部）被授予“保护臭氧层政策和实施领导奖”。

To commemorate the 30th anniversary of the signing of the Montreal Protocol, at the Twenty-ninth meeting of the parties to the Montreal Protocol, held in Montreal, Canada, on 23 November 2017, The Ministry of Ecology and Environment of China (formerly the Ministry of Environmental Protection) was awarded the "Ozone Layer Protection Policy and Implementation Leadership Award".



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- ❖ 来自中国制冷空调行业的冰轮环境技术股份有限公司承担的“冷冻冷藏用NH₃/CO₂复叠制冷系统替代R22示范项目”荣获《蒙特利尔议定书》30周年“保护臭氧层示范项目奖”。

Moon Environment Technology Co., Ltd. from Chinese Industry was awarded "the Ozone layer Protection demonstration Project Award" for its demonstration project of " NH₃/CO₂ cascade refrigeration system for refrigeration cold storage replacing R22 ".



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- ❖ 2017年9月12日，值《蒙特利尔议定书》签署30周年之际，在北京召开的国际保护臭氧层日纪念大会上，中国制冷空调工业协会、中国家用电器协会以及格力、美的、海尔、美芝、烟台冰轮、清华同方、南京天加、汉钟精机、合肥通用机械研究院等单位因为在保护臭氧层事业中做出的积极贡献获得表彰。

On September 12, 2017, at the occasion of the 30th anniversary of the signing of the Montreal Protocol, at the International Day for the Protection of the Ozone Layer commemorative meeting held in Beijing, CRAA, CHEAA, Gree, Midea, Haier, GMCC, Yantai Ice Wheel, Tsinghua Tongfang, Nanjing Tianjia, Hanzhong Precision Machinery, and Hefei General Machinery Research Institute and others were recognized and awarded for their active contributions.



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- ❖ CO₂/NH₃复叠技术产品先后荣获中国“国家重点新产品”及“改革开放40周年机械工业杰出产品”称号。

The CO₂/NH₃ cascade technology products have successively won the titles of “National Key New Product” and “Outstanding Product of Machinery Industry in the 40th Anniversary of Reform and Opening Up”.

3 结束语

Conclusions



- ❖ 保护臭氧层，减缓全球变暖是当前国际社会所共同面对的重大环境保护责任和义务，多年来中国制冷空调行业在ODS淘汰转换进程中，积极推进环境友好的绿色替代技术应用及产品能效水平的提升，取得了巨大的综合环境效益，为全球的臭氧层保护和节能减排事业做出了突出的贡献。

Protecting the ozone layer and mitigating global warming is a major environmental protection responsibility and obligation faced by the international community. For many years, China's R&AC industry has actively promoted the application of environmental friendly alternative technologies and improved energy efficiency in the HPMP implementation process. The improvement has achieved huge comprehensive environmental benefits, and has made outstanding contributions to the global ozone layer protection and energy conservation and emission reduction.

3 结束语

Conclusions



- ❖ 面对世界范围内的环境保护领域的重大挑战，国际社会必须携起手来，进一步加强交流和合作，积极探寻更加绿色高效可持续的替代技术和行业解决方案，为实现ODS完全淘汰和减缓全球变暖做出更多有价值的努力和贡献！

Facing the major challenges in the environmental protection, the international community should strengthen exchange and cooperation, actively explore more green, efficient and sustainable alternative technologies and industry solutions. It will make more contributions to the ODS phase out and global warming mitigating.



谢谢!

Thank you!